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Assessing University Contributions to Sustainability in Europe: A Data-Driven Analysis of SDG 12 (Responsible Consumption) and SDG 13 (Climate Action)

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Abstract: With intensifying demands for sustainability in higher education—particularly tied to the United Nations' Sustainable Development Goals (SDGs)—universities remain central to fostering responsible consumption and climate action. However, a significant gap persists in quantifying how effectively higher education institutions (HEIs) contribute to SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action). The extant literature has largely relied on qualitative evidence or limited case studies, lacking comprehensive, data-driven comparisons across nations. This study addresses the existing gap in the literature by applying data envelopment analysis (DEA) to assess how efficiently European universities bolster sustainable consumption and climate initiatives. Drawing on secondary data from the 2023 Times Higher Education (THE) Impact Rankings and the Sustainable Development Report, this method provides new insights on how HEIs coordinate with their countries' broader sustainability objectives. Our results show differences in efficiency among universities across 24 European countries, shaped by unique national contexts and policies. The study results can be used by university administrators and policymakers, who aim to improve the university contributions to achieving UN SDGs.

Keywords: higher education; sustainability; universities; Sustainable Development Goals (SDGs); SDG 12; SDG 13; efficiency

Academic Editor: Manfred Max Bergman

Received: 15 December 2024
Revised: 6 January 2025
Accepted: 7 January 2025
Published: 9 January 2025

Citation: Perović, L.M.; Mihaljević Kosor, M.; Alfirević, N. Assessing University Contributions to Sustainability in Europe: A Data-Driven Analysis of SDG 12 (Responsible Consumption) and SDG 13 (Climate Action). *World* **2025**, *6*, 11. https://doi.org/10.3390/world6010011

1. Introduction

Since adopting the United Nations' Sustainable Development Goals (SDGs) in 2015, sustainable development issues have become a focus of international policy agendas. Higher education is vital in addressing sustainability issues and promoting sustainable development and SDGs [1]. SDG 12 (Responsible Consumption) and SDG 13 (Climate Action) capture universities' environmental challenges in promoting sustainable development and SDGs. Universities and other higher education institutions (HEIs) can contribute to these goals through teaching, research, and third-mission activities. At the same time, the Data Envelopment Analysis might be used as a relevant methodological tool to analyze such contributions [2].

2. Theoretical Background

2.1. Higher Education and Sustainable Development

Higher education fosters sustainable development by contributing to knowledge creation, innovation, and dissemination of sustainability practices. Universities and other higher education institutions (HEIs) educate future professionals and leaders and instill

skills and values necessary to address environmental challenges. According to Lozano et al. [3], universities are "living labs" that can integrate sustainability into curriculum and campus and have a significant effect across academia and society. Leal Filho [4] emphasizes the sustainable development contribution to higher education through teaching, research, and the third mission. Those three dimensions of HEI activities promote sustainability literacy, green technologies, and support environmental goals. In identifying key elements of a sustainable university, Lukman and Glavič [5] stressed the importance of organizational commitment, stakeholder engagement, and sustainability integration in the HEI context.

2.2. Contributions to SDG 12 (Responsible Consumption and Production)

HEIs contribute to SDG 12 by implementing sustainable practices themselves, and serve as role models for responsible consumption and production. At the university level, green policies might promote waste reduction, energy efficiency, sustainable supply chains, and resource conservation. One such example is the University of Edinburgh, with its Zero Waste Policy [6]. Such university initiatives reduce the environmental footprint and provide learning opportunities and inspiration for students. Lozano [7] suggested that universities should act as catalysts for change by including sustainability into campus operations. shaping sustainable behaviors, and promoting a culture of responsibility.

Integrating sustainability into curricula may shape students' attitudes and behaviors toward responsible consumption. Different courses on environmental ethics, sustainable business practices, and resource management equip students with the knowledge and competencies to make sustainable choices [8]. The importance of embedding sustainability competencies in higher education and fostering transformative learning experiences that encourage critical thinking and proactive engagement with sustainability issues was also emphasized by Barth and Rieckmann [9]. There is a need to focus on interdisciplinary approaches to address the complexities of sustainable consumption and production [10].

HEIs lead innovation in sustainable production through research in renewable energy sources, green technologies, sustainable agriculture, and circular economy models. University research has contributed to developing biodegradable materials, sustainable packaging, and more efficient manufacturing processes [11]. For example, Mohan et al. [12] pointed out the importance of circular economy models aligned with the objectives of SDG 12.

When universities promote responsible consumption and production, they address multiple SDGs by fostering interdisciplinary research and collaboration [13], where potential synergetic effects can also be created [14]:

- SDG 8 (Decent Work and Economic Growth)—sustainable production practices support economic growth by fostering innovation and creating green jobs;
- SDG 9 (Industry, Innovation, and Infrastructure)—research and development in sustainable technologies contribute to building sustainable infrastructure and promoting inclusive industrialization at the regional level;
- SDG 11 (Sustainable Cities and Communities)—through their teaching, research, and community engagement, HEIs are involved in urban planning and development projects.

2.3. Contributions to SDG 13 (Climate Action)

Universities are the leading stakeholders of climate research and provide data, models, and analyses crucial for informing climate policies. Academic research on climate modeling, carbon capture and storage, and climate resilience strategies is the key element of HEIs' contribution to SDG 13 [15,16]. Leal Filho [4] also emphasized the importance of academic research in informing climate policies and strategies, as universities contribute to under-

standing and communicating the sources and effects of climate change and participate in shaping relevant solutions.

Similar to the role universities play in contributing to SDG 12, SDG 13 HEIs educate students on climate science, policy, and mitigation aspects, thus raising awareness and preparing them to tackle climate-related challenges. There are complex ways for HEIs to contribute to SDG 13, including undergraduate and graduate curricula in environmental science, sustainability studies, and climate policies relevant to promoting climate literacy and taking actionable steps toward climate mitigation [17,18]. HEIs can also facilitate innovative solutions, contributing to SDGs 12 and 13, such as sustainable supply chains [19] and other strategic partnerships among the industry, public sector, and civil society stakeholders.

Universities can also contribute to SDG 13 by developing environmentally sustainable campuses and architecture and participating in external partnerships and projects [20].

As an example of HEIs' commitment to operational sustainability, the University of British Columbia enacted a Climate Action Plan that has significantly reduced emissions [21]. Such initiatives may help set standards for other organizations to follow. Leal Filho et al. [22] noted that campus sustainability initiatives have both environmental and educational benefits, providing real-life experiences for students and promoting a culture of sustainability.

University contributions to SDG 13 may also interact with the following SDGs:

- SDG 7 (Affordable and Clean Energy)—universities' research and implementation of renewable energy sources support the transition to clean energy [23];
- SDG 15 (Life on Land)—climate action efforts help preserve terrestrial ecosystems and biodiversity [24];
- SDG 17 (Partnerships for the Goals): HEIs collaborate with governments, industries, and communities to enhance the effectiveness of climate initiatives [25].

2.4. Interactions Between SDG 12 and SDG 13

Responsible consumption and production ease the climate change patterns since the contemporary mass consumption society is a major driver of greenhouse gas emissions and other sources of pollution [26]. Universities can help change young adults' values, attitudes, and behavior and thus promote sustainable consumption [27]. In addition, their specialized research, such as products' life-cycle assessments, informs responsible consumption practices and climate mitigation strategies [28], with the relationship between academic research and teaching also emphasized by Leal Filho et al. [29].

Integrating concepts from SDG 12 and SDG 13 into education and research enables HEIs to address sustainability challenges in an inter-disciplinary manner [30], as collaboration initiatives transcend disciplines and sectors [31]. Furthermore, sustainability should be integrated into all aspects of HEI activities to address the multiple SDGs [32].

The interactions between SDG 12 and SDG 13 are also associated with other SDGs, especially the following:

- SDG 3 (Good Health and Well-Being): the reduction of pollution through sustainable practices improves health outcomes [33];
- SDG 6 (Clean Water and Sanitation): responsible consumption protects clean water by minimizing waste and pollutants [34].

2.5. National Context and Efficiency of HEIs' Contributions

National context (i.e., public policies, funding, and institutional frameworks) significantly influence the efficiency of universities in their contributions to SDGs. As expected, countries with a high commitment to sustainable development and relevant funding of sustainability-related research topics make it easy for HEIs to implement their SDG-related

initiatives more effectively [35]. This concerns government support [36] and the overall socio-economic contexts, including public policy frameworks and institutions [37].

At the national level, values and attitudes toward sustainability influence university goals and initiatives. In countries with a high regard for nature and sustainable development, universities more often have more efficient sustainability programs and thriving community outreach [38,39].

2.6. Strategies for HEIs to Remain Relevant Post-2030

Universities should continue their sustainability research efforts to remain relevant beyond the 2030 deadline for achieving SDGs. Adopting and implementing emerging technologies, such as digital tools, can improve HEI's ability to address future sustainability challenges [40]. Some authors advocate for organizational changes in universities to adapt to changing sustainability landscapes [41], and others find that continuous improvement processes and adaptive management are essential for universities to remain successful in their sustainability initiatives [42].

International collaborations provide new knowledge, resources, and best practices, which can be used to improve the university's capacity for sustainability actions. This is especially relevant for cross-sectoral, multi-stakeholder partnerships [43], in which HEIs participate to secure long-term commitment to SDGs.

A long-term view of implementing SDGs, following up with the potential new initiatives, and reaching out beyond the 2030 deadline requires integrating sustainability into universities' core mission and culture. This can be achieved by focusing on sustainability as a significant element of strategic plans, governance structures, and operational practices [44], which requires systemic and wide-ranging changes [3], including organizational change management competencies [45].

3. Methods and Data

3.1. Research Objective and Questions

Using data envelopment analysis (DEA) and Times Higher Education impact rankings to assess universities against the U.N.'s SDG 12 and SDG 13, we assessed the technical efficiency of universities in achieving their countries' overall SDG index score. Therefore, this study serves a dual objective:

- Assessing the relative efficiency of universities in contributing to SDG 12 and SDG 13 using data envelopment analysis (DEA) applied to data from the Times Higher Education (THE) impact rankings;
- Analyzing how national contexts influence these efficiencies, focusing on sustainability policies, institutional commitments, and cultural values.

This study provides a new perspective on the secondary data and offers insight into the alignment between HEIs' contributions and national sustainability performance scores. While we acknowledge the limitations of secondary data, we believe that using DEA contributes valuable new insight into the field [2].

Based on the previously presented research objectives, we identified the following specific research questions:

- How much do the higher education institutions contribute to the overall national sustainability performance (SDG index) through their contributions to SDG 12 and SDG 13?
- How does the efficiency of universities in promoting SDG 12 and SDG 13 vary across different European countries?
- What national contextual factors influence universities' efficiency in contributing to SDG 12 and SDG 13?

3.2. Methods

DEA is a non-parametric method used to evaluate the efficiency of decision-making units (DMUs) by comparing inputs to outputs [46]. DEA is especially suitable for this study due to several reasons:

- DEA accommodates the complex nature of universities' contributions to sustainability, involving various inputs (e.g., university scores on SDGs 12 and 13) and outputs (e.g., national SDG index scores). In addition, DEA is appropriate for benchmarking since it provides efficiency scores relative to the "best-performing" DMUs [46];
- DEA does not require assumptions about the functional relationship between inputs and outputs, allowing for flexibility in assessing institutions with diverse characteristics [47].

DEA uses linear programming techniques to assign observation-specific weights to outputs and inputs, maximizing the ratio of weighted outputs to inputs for each observation while adhering to specified constraints. This process effectively constructs a piecewise linear surface over the data, ensuring that actual input/output values lie either on or within this frontier. DEA can handle multiple inputs and outputs, making it a valuable tool for assessing HEI efficiency.

An output-oriented DEA model with constant returns to scale maximizes outputs with the given inputs, which is based on the assumption that increasing inputs should proportionally increase outputs, enhancing universities' ability to contribute to sustainability.

3.3. Data Sources

The input variables include the Times Higher Education (THE) average and overall scores for SDG 12 and SDG 13 at the university level. Times Higher Education impact rankings provide data that assesses university performance in achieving the United Nations' Sustainable Development Goals (SDGs). The indicators and rankings reported in the THE dataset comprehensively compare universities across four areas: research, stewardship, outreach, and teaching. The scores used in this research represent universities' performance in responsible consumption and climate action areas. The output is the overall SDG index of each country, which reflects the country's progress toward achieving all 17 SDGs.

Data for university scores were obtained from the THE impact rankings, while country-level SDG indices were sourced from the Sustainable Development Report—all the data cover 2023.

3.4. Data Collection and Preparation

We included 2023 data on universities, assessed by Times Higher Education for their SDGs 12 and 13 scores (within the THE impact rankings). We aligned the university-level data with the country-level data from the 2023 Sustainable Development Report published by the United Nations Sustainable Development Solutions Network. The university and country datasets were checked for potential errors and merged so that each university matches the appropriate national context.

4. Results

We used the output-oriented DEA, with constant returns to scale. Namely, the output-oriented DEA focuses on maximizing the output, i.e., the country's overall SDG index. In our case, the input variable is the THE average or overall SDG 12 and 13. Our approach, therefore, tests whether a country's universities, achieving high SDG 12 and SDG 13 contributions, actually increase the overall national sustainability performance as measured by the SDG index. Our choice of constant returns to scale is based on the assumption that doubling the inputs should result in doubling the outputs. In other words, we assume that

all countries face similar conditions and that scale differences (large vs. small countries) do not affect their efficiency.

We started by providing descriptive statistics of all variables used in the empirical research (Table 1). All the data refer to the year 2023. The countries included in the analysis comprise 24 European countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Table 1. Descriptive statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
SDG index	24	80.51	3.09	72.9	86.4
THE average SDG 12	22	53.91	16.82	14.4	79.3
THE overall SDG 12	22	63.54	18.77	30.9	90.5
THE average SDG 13	24	48.13	14.90	23.6	67.9
THE overall SDG 13	24	64.53	18.65	30.9	90.5

Source: Research results.

Next, we present the results of the DEA in four different models that vary by the input variable used.

Concerning the second research question, in Table 2, we look at the relationship between the average score universities in a particular country achieved concerning SDG 13 and the overall SDG index of that country. The results indicate that Croatia has the highest ranking, suggesting it is the benchmark country. In other words, it is the most efficient country regarding using its universities' performance in SDG 13 to achieve its overall SDG index. Croatia's universities, therefore, contribute to climate action and the country's overall sustainability. Second best was the Czech Republic, followed by Slovakia. Ireland is the least efficient country, achieving only a 33% efficiency level. Those variations are caused by different national contexts and policies, as suggested by the third research question.

Table 2. Impact of THE average SDG 13 on overall SDG index.

Country	Rank	Efficiency Score
Austria	14	0.45
Belgium	23	0.36
Bulgaria	16	0.42
Croatia	1	1.00
Cyprus	11	0.47
The Czech Republic	2	0.99
Denmark	17	0.39
Finland	21	0.37
France	12	0.47
Germany	18	0.38
Greece	8	0.51
Hungary	9	0.50
Ireland	24	0.33
Italy	13	0.46
Latvia	10	0.49
Lithuania	6	0.67
The Netherlands	22	0.37
Poland	7	0.63
Portugal	19	0.38

Table 2. *Cont.*

Country	Rank	Efficiency Score
Romania	4	0.88
Slovakia	3	0.97
Slovenia	5	0.70
Spain	15	0.42
Sweden	20	0.38

Source: Research results.

In Table 3, we look at the relationship between the overall score in SDG 13 and the overall SDG index of that country. Table 3 reveals a picture similar to that of Table 2. The most efficient country was the Czech Republic (which was second in Table 1), followed by Slovakia and Lithuania. The least efficient countries were Denmark, Cyprus, and Ireland.

Table 3. Impact of THE overall SDG 13 on overall SDG index.

Country	Rank	Efficiency Score
Austria	9	0.50
Belgium	21	0.36
Bulgaria	11	0.45
Croatia	7	0.62
Cyprus	23	0.35
The Czech Republic	1	1.00
Denmark	22	0.36
Finland	12	0.45
France	13	0.43
Germany	16	0.41
Greece	10	0.47
Hungary	6	0.62
Ireland	24	0.34
Italy	14	0.42
Latvia	19	0.38
Lithuania	3	0.96
The Netherlands	15	0.41
Poland	5	0.64
Portugal	20	0.37
Romania	4	0.78
Slovakia	2	0.98
Slovenia	8	0.54
Spain	18	0.41
Sweden	17	0.41

Source: Research results.

For SDG 12, we had to exclude Bulgaria and Cyprus due to data unavailability. The results are presented in Tables 4 and 5.

As in the previous case, we first look at the relationship between the average score that universities in a particular country achieved concerning SDG 12 and the overall SDG index of that country (Table 4). The benchmark country is Slovenia. Slovenia's universities, therefore, promote responsible consumption and production to add to the overall sustainability of the country. Interestingly, the second best is Slovakia. However, its results are much lower—only 0.54. The least efficient is, once again, Ireland.

Finally, in Table 5, we use the same approach previously applied to constructing Table 4, using the overall SDG 12 score. Austria is the most efficient country in this context, and Ireland is the least efficient.

Table 4. Impact of THE average SDG 12 on overall SDG index.

Country	Rank	Efficiency Score
Austria	10	0.27
Belgium	16	0.23
Croatia	3	0.39
The Czech Republic	6	0.33
Denmark	21	0.19
Finland	20	0.19
France	12	0.27
Germany	17	0.22
Greece	8	0.30
Hungary	7	0.32
Ireland	22	0.19
Italy	14	0.23
Latvia	15	0.23
Lithuania	13	0.26
The Netherlands	18	0.21
Poland	5	0.33
Portugal	9	0.27
Romania	4	0.36
Slovakia	2	0.54
Slovenia	1	1.00
Spain	11	0.27
Sweden	19	0.20

Source: Research results.

Table 5. Impact of THE overall SDG 12 on overall SDG index.

Country	Rank	Theta
Austria	1	1.00
Belgium	20	0.36
Croatia	11	0.44
The Czech Republic	6	0.55
Denmark	21	0.35
Finland	13	0.42
France	10	0.44
Germany	16	0.42
Greece	9	0.47
Hungary	8	0.51
Ireland	22	0.34
Italy	17	0.41
Latvia	18	0.41
Lithuania	3	0.95
The Netherlands	12	0.42
Poland	5	0.64
Portugal	14	0.42
Romania	4	0.93
Slovakia	2	0.96
Slovenia	7	0.54
Spain	15	0.42
Sweden	19	0.39

Source: Research results.

5. Discussion

5.1. Discussion of Empirical Results

The empirical analysis using DEA effectively addresses the research objectives. Regarding the first objective, we calculated efficiency scores for universities across 24 European countries and found significant variations. Universities in Croatia, the Czech Republic, and Slovenia have high-efficiency levels and may serve as benchmarks for promoting responsible consumption and climate action. For instance, the University of Ljubljana's initiatives align closely with national sustainability policies, which are associated with its high efficiency score [48].

Concerning the second objective, the influence of national contexts on efficiency was analyzed. The findings suggest that countries with supportive sustainability policies and strong institutional commitments enable universities to maximize their impact on SDGs 12 and 13 [49,50].

The DEA results show significant differences in efficiency scores from the 24 European countries analyzed. Empirical data show that Croatia, the Czech Republic, and Slovenia demonstrate high efficiency levels in building upon university contributions to enhance national sustainability performance (measured by the country's SDG index). These findings align with the theoretical claims that universities are critical in advancing SDG 12 and 13 [2], especially in countries with supportive national policies, strong institutional commitment, and cultural values oriented toward natural sustainability. For example, the University of Zagreb in Croatia demonstrates high efficiency in promoting responsible consumption practices, while universities in Slovenia excel in climate action initiatives.

Our results align with the opinion of Lukman and Glavič [3], who emphasized the role of external factors, including national policies and social expectations, in integrating sustainability into higher education. Countries with robust environmental legislation and a cultural emphasis on sustainability tend to have universities with higher efficiency in contributing to SDGs 12 and 13. This empirical evidence highlights the importance of supportive national environments in improving the HEI impact on sustainability goals [49].

There are various factors contribution to the national efficiency ranks:

- Countries with comprehensive sustainability policies can create a national context in which the universities are also empowered and motivated to engage in sustainability initiatives and activities [36];
- Universities with strong leadership and organizational commitment to sustainability are more likely to be efficient [45];
- Societies with high cultural regard for environmental sustainability support university efforts by encouraging HEI community outreach and multi-stakeholder collaborations [39].

5.2. Policy Implications and Recommendations

Several policy implications can be identified based on the empirical findings and theoretical insights. Firstly, there should be an additional emphasis on the university–government collaboration, while other stakeholders should be invited to participate in HEIs' research, teaching and outreach activities. Secondly, adequate funding and partners' resources can be used to support HEIs' sustainability initiatives and their effectiveness. Thirdly, promoting cultural change by encouraging a shift toward valuing sustainability can influence universities to prioritize SDG-related activities. Finally, fostering knowledge exchange by creating platforms for universities to share best practices can help less efficient institutions learn from high-performing partners in all socio-economic sectors.

5.3. Research Limitations

While the Times Higher Education (THE) impact rankings provide valuable assessment of universities' contributions to SDGs, several limitations need to be acknowledged:

- Participation in THE impact rankings is voluntary, which might lead to self-selection bias, where universities already engaged in sustainability initiatives are overrepresented. It should also be noted that institutions in non-English-speaking countries or those with different cultural approaches to sustainability may be underrepresented or misrepresented in the rankings [51];
- Variations in reporting standards and practices across institutions and countries can affect data comparability. Some universities may have more resources to collect and report data, influencing their rankings. In addition, the rankings may not fully capture qualitative aspects of universities' sustainability efforts, such as community engagement or local (regional) initiatives [52].

These limitations suggest that the presented data should be interpreted cautiously. Future research should consider combining the THE impact rankings data with additional sources or developing additional evaluation indicators and frameworks to capture the different dimensions of universities' contributions to sustainability.

6. Conclusions

This paper highlights the significant role of higher education institutions in achieving SDG 12 and SDG 13 and influencing their countries' SDG scores. The theoretical framework emphasizes the multidimensional contributions of universities through sustainable operations, education, research, and community engagement. The empirical analysis using DEA revealed differences in efficiency among European countries, influenced by national contexts and policies.

By integrating theoretical insights with empirical findings, we demonstrate that supportive national environments enable universities to maximize their impact on sustainability. To remain relevant beyond the 2030 agenda, HEIs must continue to innovate, develop global, inter-sectoral, and multi-stakeholder partnerships, and embed sustainability into their organizational cultures.

Author Contributions: Conceptualization, L.M.P., M.M.K. and N.A.; formal analysis, L.M.P.; investigation, L.M.P. and M.M.K.; methodology, L.M.P.; project administration, N.A.; supervision, N.A.; validation, M.M.K.; writing—original draft, L.M.P., M.M.K. and N.A.; writing—review and editing, L.M.P., M.M.K. and N.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable, as this study does not involve research on humans or animals.

Informed Consent Statement: Not applicable, as this study does not involve research on humans.

Data Availability Statement: Data are contained within the article.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Shulla, K.; Filho, W.L.; Lardjane, S.; Sommer, J.H.; Borgemeister, C. Sustainable Development Education in the Context of the 2030 Agenda for Sustainable Development. *Int. J. Sustain. Dev. World Ecol.* **2020**, *27*, 458–468. [CrossRef]
2. Puertas, R.; Marti, L. Sustainability in Universities: DEA-GreenMetric. *Sustainability* **2019**, *11*, 3766. [CrossRef]
3. Lozano, R.; Lukman, R.; Lozano, F.J.; Huisingh, D.; Lambrechts, W. Declarations for Sustainability in Higher Education: Becoming Better Leaders, Through Addressing the University System. *J. Clean. Prod.* **2013**, *48*, 10–19. [CrossRef]

4. Leal Filho, W. About the Role of Universities and Their Contribution to Sustainable Development. *High. Educ. Policy* **2011**, *24*, 427–438. [CrossRef]
5. Lukman, R.; Glavič, P. What Are the Key Elements of a Sustainable University? *Clean. Technol. Environ. Policy* **2007**, *9*, 103–114. [CrossRef]
6. University of Edinburgh. Zero Waste Policy. Available online: https://sustainability.ed.ac.uk/operations/zero-waste (accessed on 16 October 2023).
7. Lozano, R. A Holistic Perspective on Corporate Sustainability Drivers. *Corp. Soc. Responsib. Environ. Manag.* **2015**, *22*, 32–44. [CrossRef]
8. Sterling, S. Higher Education, Sustainability, and the Role of Systemic Learning. In *Sustainability Education*; Wals, A.E.J., Ed.; Routledge: London, UK, 2010; pp. 49–70.
9. Barth, M.; Rieckmann, M. Academic Staff Development as a Catalyst for Curriculum Change Towards Education for Sustainable Development: An Output Perspective. *J. Clean. Prod.* **2012**, *26*, 28–36. [CrossRef]
10. Leal Filho, W.; Shiel, C.; do Paço, A. Integrative Approaches to Environmental Sustainability at Universities: An Overview of Challenges and Priorities. *J. Integr. Environ. Sci.* **2015**, *12*, 1–14. [CrossRef]
11. Leal Filho, W. *Implementing Sustainable Development in the Curriculum of Universities: Approaches, Methods and Projects*; Springer: Cham, Switzerland, 2017.
12. Mohan, S.V.; Nikhil, G.N.; Chiranjeevi, P.; Reddy, C.N.; Rohit, M.V.; Kumar, A.N.; Sarkar, O. Waste Biorefinery Models Towards Sustainable Circular Bioeconomy: Critical Review and Future Perspectives. *Bioresour. Technol.* **2016**, *215*, 2–12. [CrossRef]
13. Trencher, G.; Yarime, M.; McCormick, K.B.; Doll, C.N.; Kraines, S.B. Beyond the Third Mission: Exploring the Emerging University Function of Co-creation for Sustainability. *Sci. Public. Policy* **2014**, *41*, 151–179. [CrossRef]
14. Xiao, H.; Liu, Y.; Ren, J. Synergies and Trade-Offs Across Sustainable Development Goals: A Novel Method Incorporating Indirect Interactions Analysis. *Sustain. Dev.* **2023**, *31*, 1135–1148. [CrossRef]
15. Pachauri, R.K.; Meyer, L.A. *Climate Change 2014: Synthesis Report*; Intergovernmental Panel on Climate Change: Geneva, Switzerland, 2014.
16. Markard, J.; Raven, R.; Truffer, B. Sustainability Transitions: An Emerging Field of Research and Its Prospects. *Res. Policy* **2012**, *41*, 955–967. [CrossRef]
17. Molthan-Hill, P.; Blaj-Ward, L.; Mbah, M.F.; Ledley, T.S. Climate Change Education at Universities: Relevance and Strategies for Every Discipline. In *Handbook of Climate Change Mitigation and Adaptation*; Chen, W.-Y., Suzuki, T., Lackner, M., Eds.; Springer International Publishing: Cham, Switzerland, 2022; pp. 3395–3457. [CrossRef]
18. Lozano, R. Diffusion of Sustainable Development in Universities' Curricula: An Empirical Example from Cardiff University. *J. Clean. Prod.* **2010**, *18*, 637–644. [CrossRef]
19. Kmetec, A.; Rosi, B.; Mlaker Kač, S. The Importance of Partnerships in Supply Chains. *Management* **2019**, *24*, 95–106. [CrossRef]
20. Cortese, A.D. The Critical Role of Higher Education in Creating a Sustainable Future. *Plan. High. Educ.* **2003**, *31*, 15–22.
21. University of British Columbia. Climate Action Plan 2020–2030. Available online: https://climateemergency.ubc.ca/ (accessed on 16 October 2023).
22. Leal Filho, W. *Implementing Campus Greening Initiatives: Approaches, Methods and Perspectives*; Springer: Cham, Switzerland, 2015. [CrossRef]
23. Brown, M.A.; Sovacool, B.K. *Climate Change and Global Energy Security: Technology and Policy Options*; MIT Press: Cambridge, MA, USA, 2011.
24. Díaz, S.; Settele, J.; Brondízio, E.S.; Ngo, H.T.; Agard, J.; Arneth, A.; Balvanera, P.; Brauman, K.A.; Butchart, S.H.; Chan, K.M.; et al. Pervasive Human-driven Decline of Life on Earth Points to the Need for Transformative Change. *Science* **2019**, *366*, eaax3100. [CrossRef]
25. Pattberg, P.; Widerberg, O. The Climate Change Regime. In *Research Handbook on Climate Governance*; Pattberg, P., Zelli, F., Eds.; Edward Elgar Publishing: Cheltenham, UK, 2018; pp. 3–12.
26. Geels, F.W.; McMeekin, A.; Mylan, J.; Southerton, D. A Critical Appraisal of Sustainable Consumption and Production Research: The Reformist, Revolutionary and Reconfiguration Positions. *Glob. Environ. Chang.* **2015**, *34*, 1–12. [CrossRef]
27. Schoolman, E.D.; Shriberg, M.; Schwimmer, S.; Tysman, M. Green Cities and Ivory Towers: How Do Higher Education Sustainability Initiatives Shape Millennials' Consumption Practices? *J. Environ. Stud. Sci.* **2016**, *6*, 490–502. [CrossRef]
28. Jackson, T. Sustainable Consumption. In *Handbook of Sustainable Development*; Atkinson, G., Dietz, S., Neumayer, E., Eds.; Edward Elgar Publishing: Cheltenham, UK, 2007; pp. 254–268. [CrossRef]
29. Leal Filho, W.; Brandli, L.; Kuznetsova, O.; Paco, A. *Integrative Approaches to Sustainable Development at University Level—Making the Links*; Springer: Cham, Switzerland, 2015. [CrossRef]
30. Žalėnienė, I.; Pereira, P. Higher Education for Sustainability: A Global Perspective. *Geogr. Sustain.* **2021**, *2*, 99–106. [CrossRef]
31. Trencher, G.P.; Yarime, M.; Kharrazi, A. Co-creating Sustainability: Cross-sector University Collaborations for Driving Sustainable Urban Transformations. *J. Clean. Prod.* **2013**, *134*, 85–97. [CrossRef]

32. Kohl, K.; Hopkins, C.; Barth, M.; Michelsen, G.; Dlouhá, J.; Razak, D.A.; Abidin Bin Sanusi, Z.; Toman, I. Whole-Institution Approach Towards Sustainability: A Crucial Aspect of Higher Education's Individual and Collective Engagement with the SDGs and Beyond. *Int. J. Sustain. High. Educ.* **2022**, *23*, 218–236. [CrossRef]
33. UNESCO. *Education for Sustainable Development Goals: Learning Objectives*; UNESCO Publishing: Paris, France, 2017.
34. Tilbury, D. Higher Education for Sustainability: A Global Overview of Commitment and Progress. In *Higher Education in the World*; MacGregor, K., Santiago, A., Cadorin, M., Eds.; Global University Network for Innovation (GUNI) Series on the Social Commitment of Universities; Palgrave Macmillan: London, UK, 2011; pp. 18–28.
35. Tilbury, D. *Education for Sustainable Development: An Expert Review of Processes and Learning*; UNESCO: Paris, France, 2011.
36. Leal Filho, W.; Azeiteiro, U.M.; Alves, F. *Climate Change and Sustainable Development: Ethical Perspectives on Land Use and Food Production*; Springer: Cham, Switzerland, 2016.
37. Wright, T.S.A.; Horst, N. Exploring the Ambiguity: What Faculty Leaders Really Think of Sustainability in Higher Education. *Int. J. Sustain. High. Educ.* **2013**, *14*, 209–227. [CrossRef]
38. Ferrer-Balas, D.; Adachi, J.; Banas, S.; Davidson, C.I.; Hoshikoshi, A.; Mishra, A.; Motodoa, Y.; Onga, M.; Ostwald, M. An International Comparative Analysis of Sustainability Transformation Across Seven Universities. *Int. J. Sustain. High. Educ.* **2008**, *9*, 295–316. [CrossRef]
39. Fam, D.; Palmer, J.; Riedy, C.; Mitchell, C. *Transdisciplinary Research and Practice for Sustainability Outcomes*; Routledge: London, UK, 2016.
40. Baker-Shelley, A.; van Zeijl-Rozema, A.; Martens, P. A Conceptual Synthesis of Organisational Transformation: How to Diagnose, and Navigate, Pathways for Sustainability at Universities? *J. Clean. Prod.* **2017**, *145*, 262–276. [CrossRef]
41. Lozano, R.; Ceulemans, K.; Scarff Seatter, C. Teaching Organisational Change Management for Sustainability: Designing and Delivering a Course at the University of Leeds to Better Prepare Future Sustainability Change Agents. *J. Clean. Prod.* **2015**, *106*, 205–215. [CrossRef]
42. Leal Filho, W.; Wu, Y.C.; Brandli, L.L.; Avila, L.V.; Azeiteiro, U.M.; Caeiro, S.; Madruga, L.R. Identifying and Overcoming Obstacles to the Implementation of Sustainable Development at Universities. *J. Integr. Environ. Sci.* **2017**, *14*, 93–108. [CrossRef]
43. Stephens, J.C.; Hernandez, M.E.; Román, M.; Graham, A.C.; Scholz, R.W. Higher Education as a Change Agent for Sustainability in Different Cultures and Contexts. *Int. J. Sustain. High. Educ.* **2008**, *9*, 317–338. [CrossRef]
44. Lozano, R. Incorporation and Institutionalization of S.D. into Universities: Breaking Through Barriers to Change. *J. Clean. Prod.* **2006**, *14*, 787–796. [CrossRef]
45. Lozano, R.; Merrill, M.Y. Leading Change for Sustainability: The Role of Senior Leaders in Higher Education. In *Sustainability Assessment Tools in Higher Education Institutions*; Springer: Cham, Switzerland, 2017; pp. 133–146.
46. Johnes, J. Data Envelopment Analysis and Its Application to the Measurement of Efficiency in Higher Education. *Econ. Educ. Rev.* **2006**, *25*, 273–288. [CrossRef]
47. Cooper, W.W.; Seiford, L.M.; Tone, K. *Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software*, 2nd ed.; Springer: New York, NY, USA, 2007. [CrossRef]
48. Leal Filho, W.; Shiel, C.; do Paço, A. Implementing and Operationalising Integrative Approaches to Sustainability in Higher Education: The Role of Project-Oriented Learning. *J. Clean. Prod.* **2019**, *133*, 126–135. [CrossRef]
49. Shiel, C.; Leal Filho, W.; do Paço, A.; Brandli, L. Evaluating the Engagement of Universities in Capacity Building for Sustainable Development in Local Communities. *Eval. Program Plan.* **2016**, *54*, 123–134. [CrossRef]
50. Veiga Ávila, L.; Leal Filho, W.; Brandli, L.L.; MacGregor, C.J.; Molthan-Hill, P.; Özuyar, P.G.; Moreira, R.M. Barriers to Innovation and Sustainability at Universities around the World. *J. Clean. Prod.* **2018**, *164*, 1268–1278. [CrossRef]
51. Rauhvargers, A. *Global University Rankings and Their Impact*; European University Association: Brussels, Belgium, 2013. Available online: https://www.eua.eu/publications/reports/global-university-rankings-and-their-impact.html (accessed on 5 December 2024).
52. Soh, K. The Seven Deadly Sins of World University Ranking: A Summary from Several Papers. *J. High. Educ. Policy Manag.* **2017**, *39*, 104–115. [CrossRef]